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September 20, 2010

U.S. Environmental Protection Agency
Ms. Stephanie Linebaugh
Superfund Division – RRS 3, Mail Code SR-6J
77 West Jackson Boulevard
Chicago, Illinois 60604-3507

U.S. Environmental Protection Agency
Mr. Ken Bardo
RCRA Corrective Action Section, Mail Code LU-9J
77 West Jackson Boulevard
Chicago, Illinois 60604-3507

Re: Preliminary Evaluation of Sauget Groundwater

1631210006 – St. Clair Co. Sauget/W.G. Krummrich Plant Compliance File	1630200005 – St. Clair Sauget Area 1 Sites Superfund/Tech Reports	1631215032 – St. Clair Co. Sauget Area 2 Sites Superfund/Tech Reports

Dear Ms. Linebaugh and Mr. Bardo:

On behalf of the State of Illinois Natural Resource Damages Trustees, the Illinois Environmental Protection Agency (Illinois EPA) is transmitting the above referenced memorandum. The Preliminary Evaluation of Sauget Groundwater Data was generated by Stratus Consulting, Inc. while reviewing groundwater data and models for the Sauget Industrial Corridor. Stratus identifies potential anomalies and data gaps relied upon in contaminant fate and transport reports submitted for the W.G. Krummrich Plant and the Sauget Areas 1 and 2 sites.

After reviewing the enclosed information and given the advanced stage of environmental investigation at these sites, the State Trustees request a meeting or conference call to discuss what follow-on actions may be warranted regarding the potential anomalies and data gaps.

Should you have any questions regarding this letter, please do not hesitate to contact me by phone at 217/785-7728 or by e-mail at *Paul.Lake@illinois.gov*.

Sincerely,

Paul T. Lake, Remedial Project Manager
Federal Facilities Unit
Bureau of Land

PTL:bac:rac:h:\site files\Sauget\NRDA\Cover ltr GW Eval Memo to USEPA 092010.doc

Attachment: Preliminary Evaluation of Sauget Groundwater Data

cf: Donald Bruce, U.S.EPA Region 5, RRS 3 Section Chief,
Todd Rettig, IDNR
Frank Horvath, USFWS

Memorandum

To:	Tom Heavisides and Todd Rettig, Illinois Department of Natural Resources
cc:	Paul Lake, Illinois Environmental Protection Agency Michelle Ryan, Illinois Environmental Protection Agency Jim Morgan, Illinois Attorney General's Office
From:	Jamie Holmes, Stratus Consulting Inc.
Date:	9/3/2010
Subject:	Preliminary evaluation of Sauget groundwater data

Stratus Consulting has reviewed recent, relevant groundwater data and models that are applicable to contaminant fate and transport at the Sauget Industrial Complex and the W.G. Krummrich plant ("the Sauget site"). This memorandum summarizes these data and describes potential anomalies and data gaps.

First, we discuss a recent groundwater model that TBirdie Consulting prepared for the Illinois Department of Transportation (IDOT). TBirdie Consulting modeled groundwater pumping from well fields in low-lying sections of interstate highways and provided IDOT with recommendations to ensure that the highways remain above the water table. We then discuss the regional flow model that was prepared for the Sauget site and how the assumptions in this model differ from those in the TBirdie model. Next, we discuss 2008 and 2009 Remedial Investigation (RI) data on groundwater contamination and possible anomalies in these data. Finally, we present recommendations to address modeling inconsistencies and data gaps.

1. IDOT Model

In 2009, TBirdie Consulting reviewed the IDOT dewatering well fields on I-55, I-70, and I-64 in East St. Louis, Illinois (TBirdie Consulting, 2009a, 2009b). These dewatering well fields are approximately 2 to 3 miles north-northeast of the Sauget site (Figures 1 and 2). Since the 1960s, IDOT has been required to pump a substantial amount of groundwater from these well fields to keep the water table below the roadbed. According to TBirdie Consulting (2009a):

- Under normal conditions, the wells pump approximately 8,300 gallons per minute (gpm), or 12 million gallons per day (mgd)
- Under flood conditions, the wells can pump over 13,900 gpm, or 20 mgd
- The Missouri Ave. wells (Figure 2), which are closest to the Sauget site (Figure 1), pump approximately 3,000 to 4,000 gpm during normal conditions and over 5,000 gpm at high river flow.

Figure 1. The Sauget and W.G. Krummrich sites in Sauget, Illinois, and the IDOT well fields in East St. Louis, Illinois.

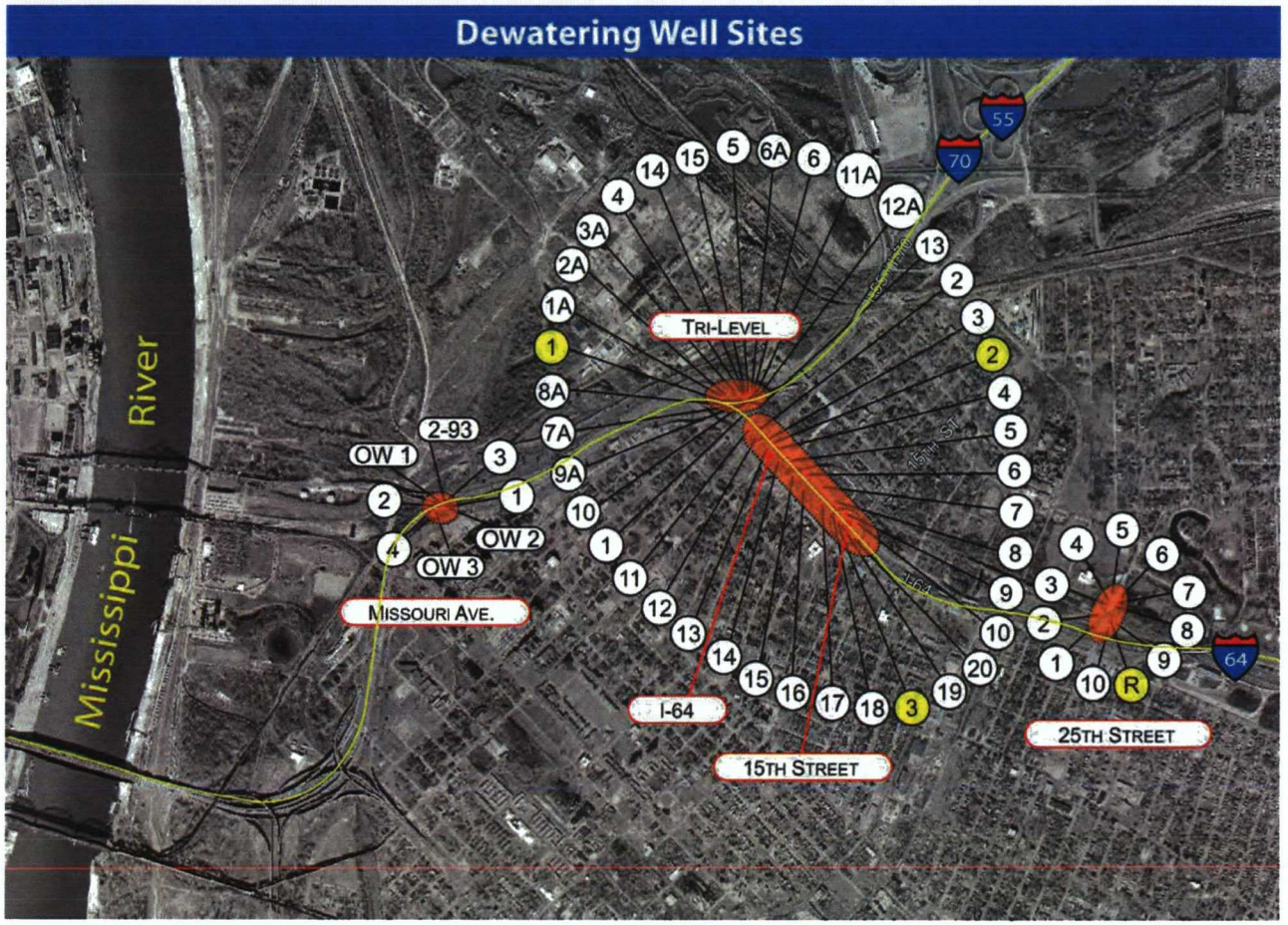

Figure 2. IDOT dewatering well fields in East St. Louis, Illinois. White circles are pumping wells; yellow circles are wells where water levels are recorded (TBirdie Consulting, 2009a, Figure 1-3).

Source: TBirdie Consulting, 2009b.

TBirdie Consulting modeled the quantity of water that IDOT will need to pump during a low-probability, large flood event and evaluated whether the existing infrastructure would be capable of pumping that quantity of water. In their model, they set a no-flow boundary on the southern border of East St. Louis (Figure 3). We are not aware of any subsurface features that would prevent alluvial groundwater from flowing across this boundary. In fact, the GSI Environmental (2008) regional flow model (see Section 2) states that the cone of depression from IDOT pumping has extended to Sauget. Thus, it is possible that TBirdie Consulting has underestimated the quantity of water that will flow toward the pumping wells from the south, leading to overestimates of the amount of groundwater drawdown.

Even with the assumption of a no-flow boundary close to these well fields, TBirdie Consulting (2009a, 2009b) concluded that the existing well network is insufficient to keep groundwater below the road grade during a low-probability, large flood event. They recommend installation of 16 new wells, including 6 additional wells at Missouri Ave. (Figure 4), increasing the pumping capacity to 6,600 gpm to handle a large flood event.

In summary, IDOT has been pumping groundwater continuously from the interstate well fields for many years. TBirdie Consulting recommends that additional wells be installed and pumping be increased to ensure that the water table remains below the roadbeds.

2. American Bottoms Regional Groundwater Model

GSI Environmental (2008) created a regional groundwater flow and contaminant transport model for the American Bottoms aquifer system in the vicinity of Sauget as part of the remedial activities at the Sauget site. GSI Environmental sought to verify that groundwater contamination at the Sauget site generally moves from source areas west toward the Mississippi River, and that the groundwater migration control system (GMCS) at Site R would capture the majority of the contaminants.

Although alluvial groundwater tends to flow toward rivers, the IDOT highway dewatering system has the potential to influence groundwater flow at Sauget. For example, GSI Environmental (2008) notes that a 1990 potentiometric surface map clearly shows the IDOT cone of depression extending into the Sauget area, and they state, "Historical... highway dewatering activities have had significant effects on the distribution of the observed contaminant plumes today" (GSI Environmental, 2008, p. TRANSPORT-2). However, when calibrating their model, they claim that no IDOT pumping data were available after 1994, and they assume that IDOT reduced their pumping rate through the 2000s and will stop pumping altogether in 2010. Specific errors include:

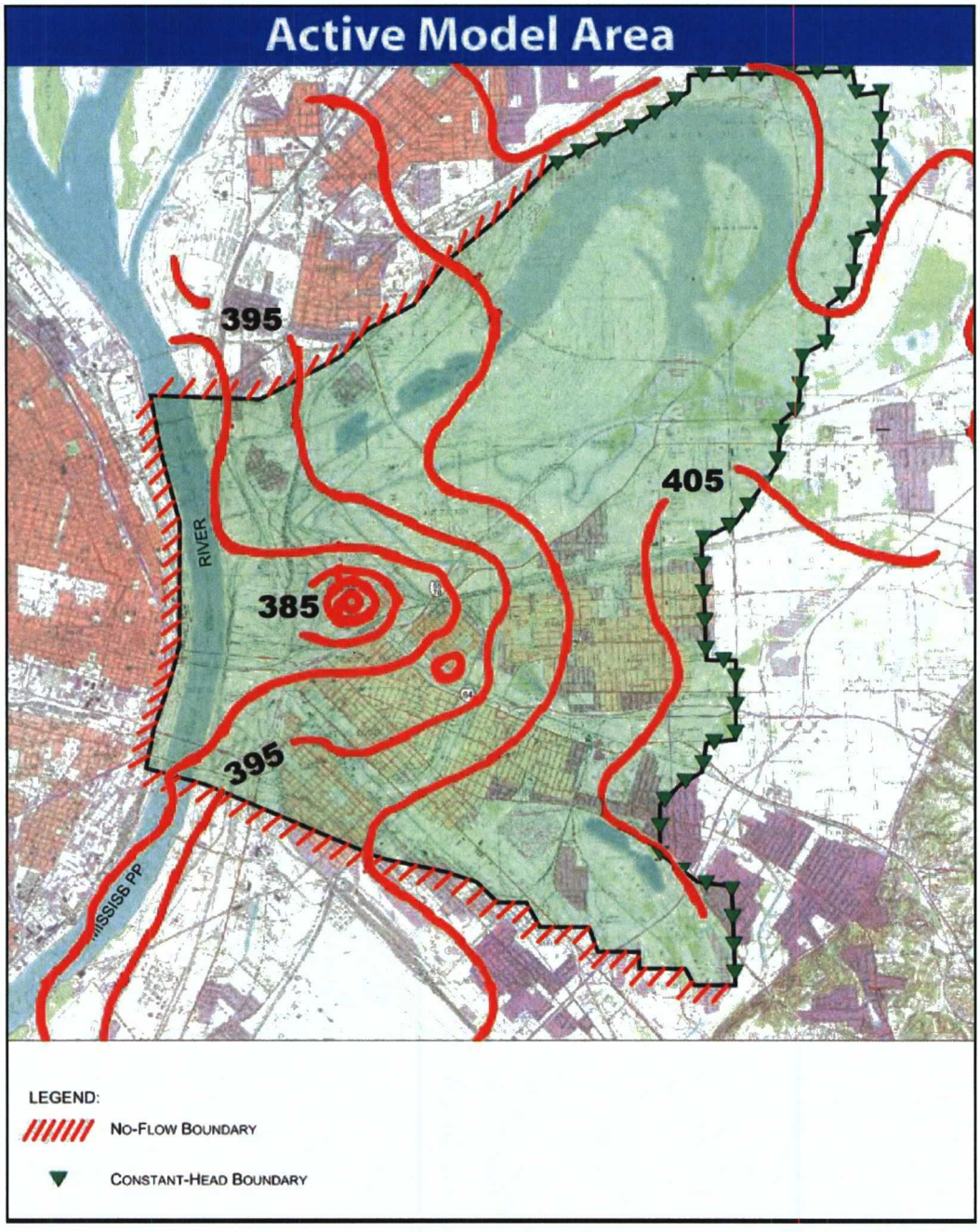

Figure 3. Model domain of the TBirdie Consulting groundwater model. It is unlikely that the no-flow boundary to the south is accurate.

Source: TBirdie Consulting, 2009b, Slide 11.

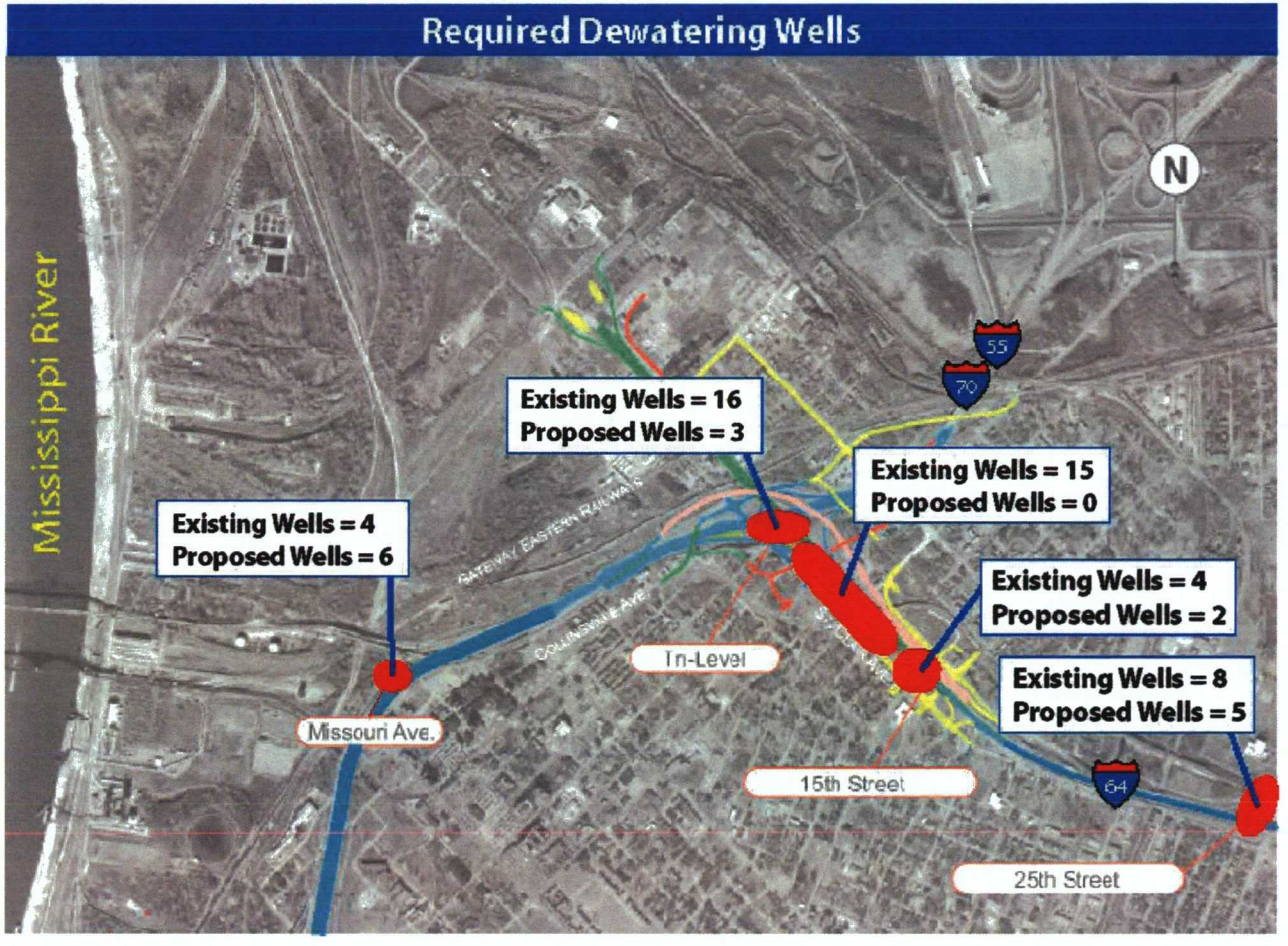

Figure 4. TBirdie Consulting recommendations for increasing the capacity of the IDOT dewatering capabilities.

Source: TBirdie Consulting, 2009b, Slide 25.

- "An initial pumping rate of 6,250 gpm was estimated to be representative of the dewatering projects" (GSI Environmental, 2008, p. FLOW-13). When calibrating the model, they adjusted this rate to 6,828 gpm. According to TBirdie Consulting (2009a), the normal pumping rate for the IDOT dewatering projects is 8,300 gpm.

- "In the early 2000s, the Krummrich plumes are oriented more north/south due to the influence of the Highway Dewatering System in East St. Louis... this Highway Dewatering System's estimated flowrate was reduced significantly in the model in 2000, and then set to zero in 2010" (GSI Environmental, 2008, p. TRANSPORT-34).

- "Based on personal communication with Solutia Inc., highway dewatering pumping was assumed to terminate in 2010 due to planned road construction projects" (GSI Environmental, 2008, p. FLOW-13).

As discussed in Section 1, IDOT did not significantly reduce their pumping in 2000, they are not planning to terminate their dewatering projects, and they have been advised that they should increase their pumping capacity to ensure that groundwater remains below the roadbed. Thus, the north-south orientation of the plumes described above may in fact still be the orientation of the plumes.

The cone of depression extending to the Sauget site that GSI Environmental (2008) notes in the 1990 potentiometric surface map is evident in their 2000 model runs as well; however, they state that they significantly reduced the highway dewatering system's flow rate in 2000. Figure 5 shows the GSI Environmental modeled chlorobenzene plume in the deep hydrogeologic unit (DHU) in 2000. Part of this modeled plume is clearly moving to the north-northeast, toward the IDOT well fields and away from the Mississippi River and the GMCS. Because IDOT continues to pump from the highway well fields, at rates substantially higher than were included in this 2000 model run, it is likely that this cone of depression still extends to source areas near the Krummrich plant, and contaminants may still be moving north-northeast rather than west toward the GMCS.

The modeled chlorobenzene plume in the DHU calibrated to 2005/2006 contaminant data does not correspond well with measured chlorobenzene concentrations at the north end of the Sauget site. Several wells north of the 0.1 mg/L contour have chlorobenzene concentrations that exceed 0.1 mg/L, including 0.9 mg/L near the north end of Site P (Figure 6). The model thus appears to underestimate the north-northeastward progression of the plume.

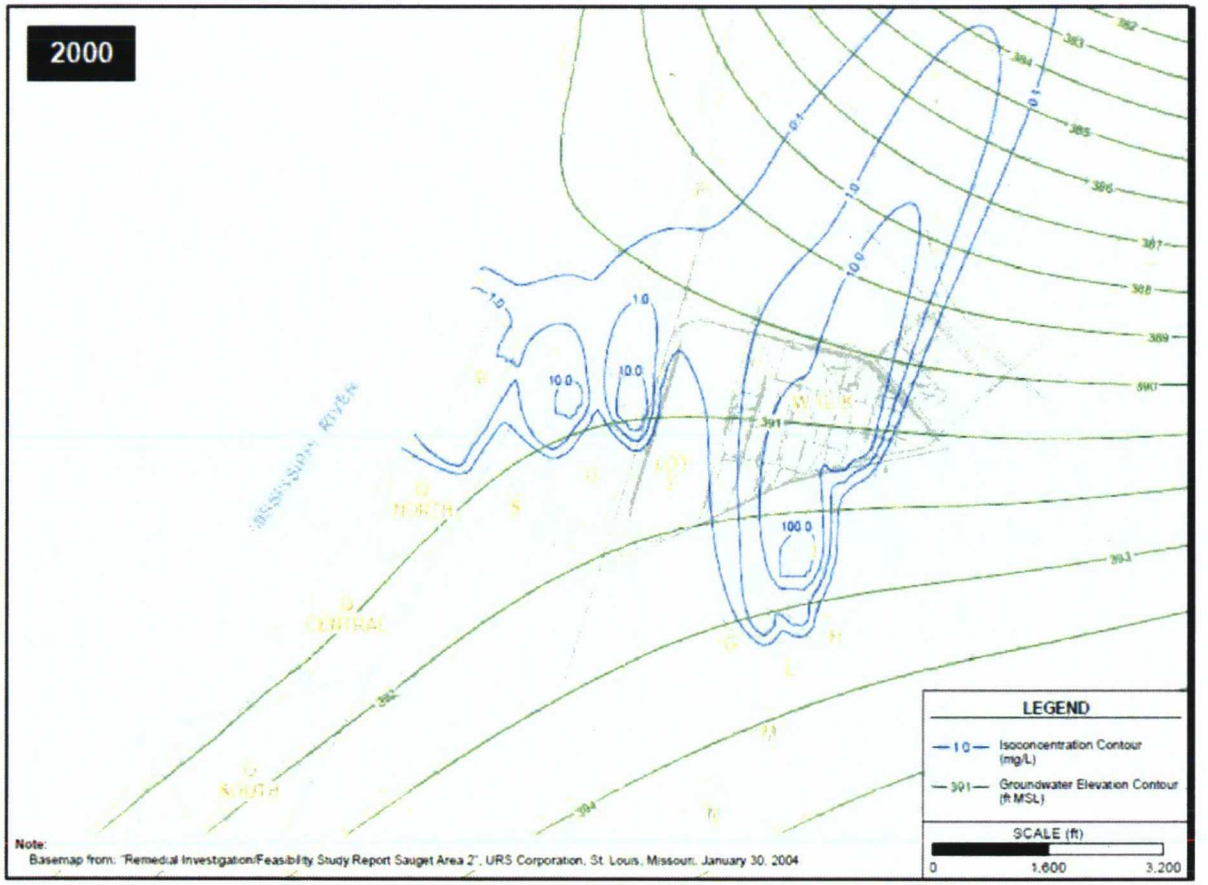

Figure 5. Modeled chlorobenzene plume in the DHU in 2000. The modeled plume indicates transport of chlorobenzene from source areas at W.G. Krummrich ("W.G.K") to the north-northeast, toward the IDOT well field and away from the Mississippi River and the GMCS at Site R.

Source: GSI Environmental, 2008, Figure 37.

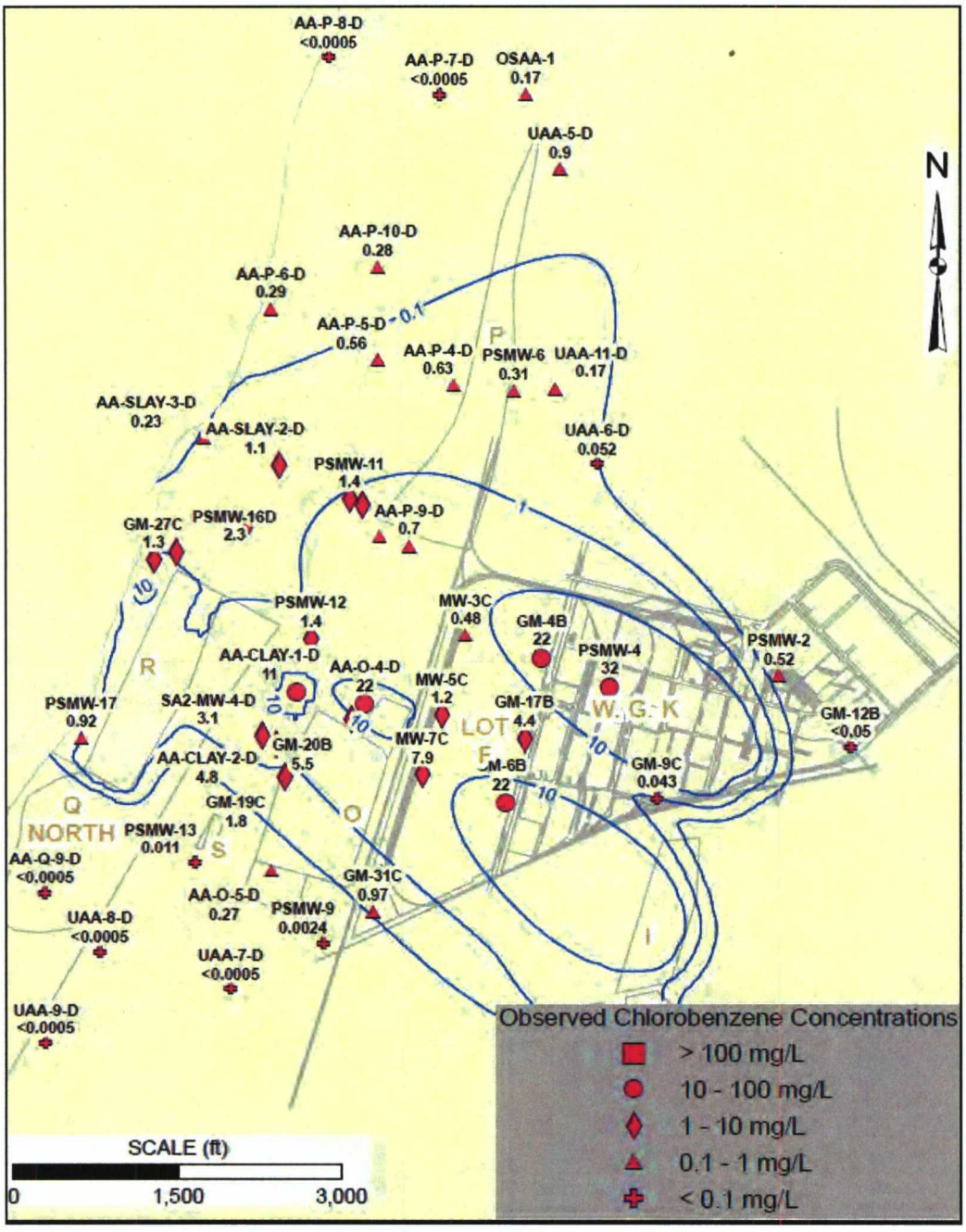

Figure 6. Modeled chlorobenzene plume in the DHU calibrated to 2005/2006 data. Several wells north of the 0.1 mg/L contour exceed 0.1 mg/L, including 0.9 mg/L near the north tip of Site P.

Source: Modified from GSI Environmental, 2008, Figure 33.

In summary, the GSI Environmental (2008) regional groundwater flow model erroneously assumes that IDOT has been reducing their pumping rates and will terminate pumping entirely in 2010. In years when they assume IDOT is pumping, they show a clear cone of depression extending to W.G. Krummrich, with contaminant transport to the north-northeast. Therefore, contaminants likely continue to migrate in that direction.

3. 2008-2009 Remedial Investigation Data

The URS (2008) RI report for Sauget Area 2 includes recent groundwater contours and contaminant concentration data for the Sauget site. The GSI Environmental (2009) RI Report for Sauget Area 1 includes groundwater contours developed from data that are now over 10 years old, and contaminant isoconcentration figures that are identical to those in the Area 2 RI; therefore, we focused on the data presented in URS (2008). Based on a rapid review of the data, we identified some groundwater data gaps, and we noted that some modeled contaminant plumes do not appear to be moving in the direction that the regional groundwater flow model (GSI Environmental, 2008) and modeled groundwater elevation contours (URS, 2008) suggest.

Figure 7 shows the URS (2008) groundwater contours for the DHU. These contours indicate that groundwater flows west toward the Mississippi River and the GMCS at Site R. However, the contours have been extrapolated into areas in which there are no data, including a large area north of W.G. Krummrich and northeast of Site P, and another large area south of W.G. Krummrich and east of Site Q Central. The area north of W.G. Krummich is where GSI Environmental (2008) showed the most influence of IDOT well pumping in their 2000 model run (Figure 5), but the contours are highly uncertain.

URS (2008) also presents groundwater isoconcentration maps for each contaminant of concern in each hydrogeologic unit (as mentioned previously, these isoconcentration maps are replicated in GSI Environmental, 2009). There are several examples of isoconcentration maps which indicate that contaminant plumes are not flowing west toward the Mississippi River and the Site R GMCS. For instance, benzene in the DHU appears to be moving northeasterly from a source west of W.G. Krummrich (Figure 8). Also, while the bulk of the chlorobenzene in the DHU appears to be moving west from a source at W.G. Krummrich toward the GMCS, chlorobenzene is present at concentrations exceeding drinking water standards in nearly every well to the north and east of source areas (Figures 9 and 10). For both benzene and chlorobenzene, there are no clean wells to the north or northeast that can be used to delineate the extent of the plume (in fact, there are almost no wells at all to the north or northeast). The plume, as depicted, is arbitrarily cut off with dotted lines near the boundary of the Sauget site (Figures 8 and 9). The locations of the northernmost contaminated wells at the Sauget site in relation to source areas near W.G. Krummrich, the GMCS at Site R, and the IDOT well fields (Figure 10) again strongly suggest north-northeastward contaminant transport. The lack of wells in this area is a substantial groundwater data gap.

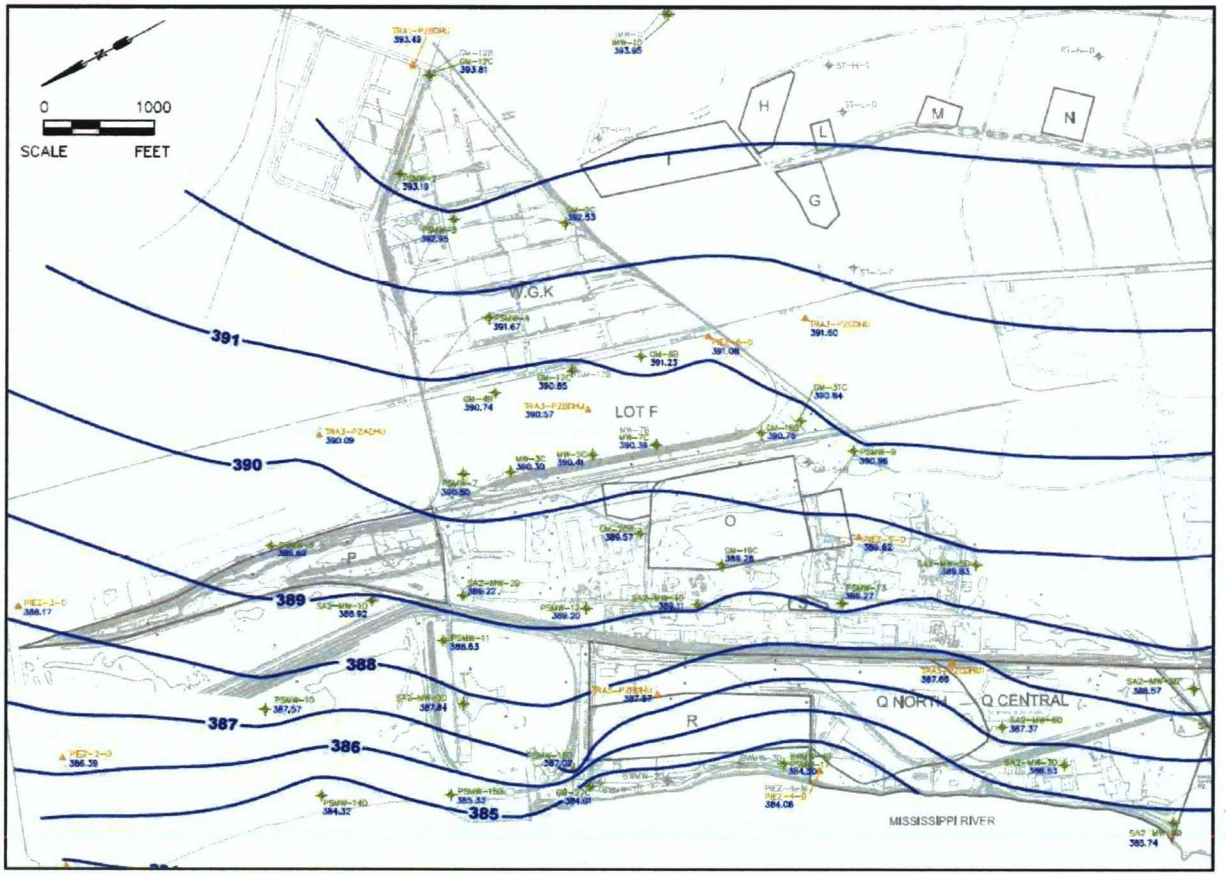

Figure 7. Groundwater elevation contours in the DHU in June 2006. Note that north is to the left. There are no data that inform these contours to the north of W.G. Krummrich ("W.G.K") and northeast of Site P, or to the south of W.G. Krummich and east of Site Q Central.

Source: Modified from URS, 2008, Figure 6-18c.

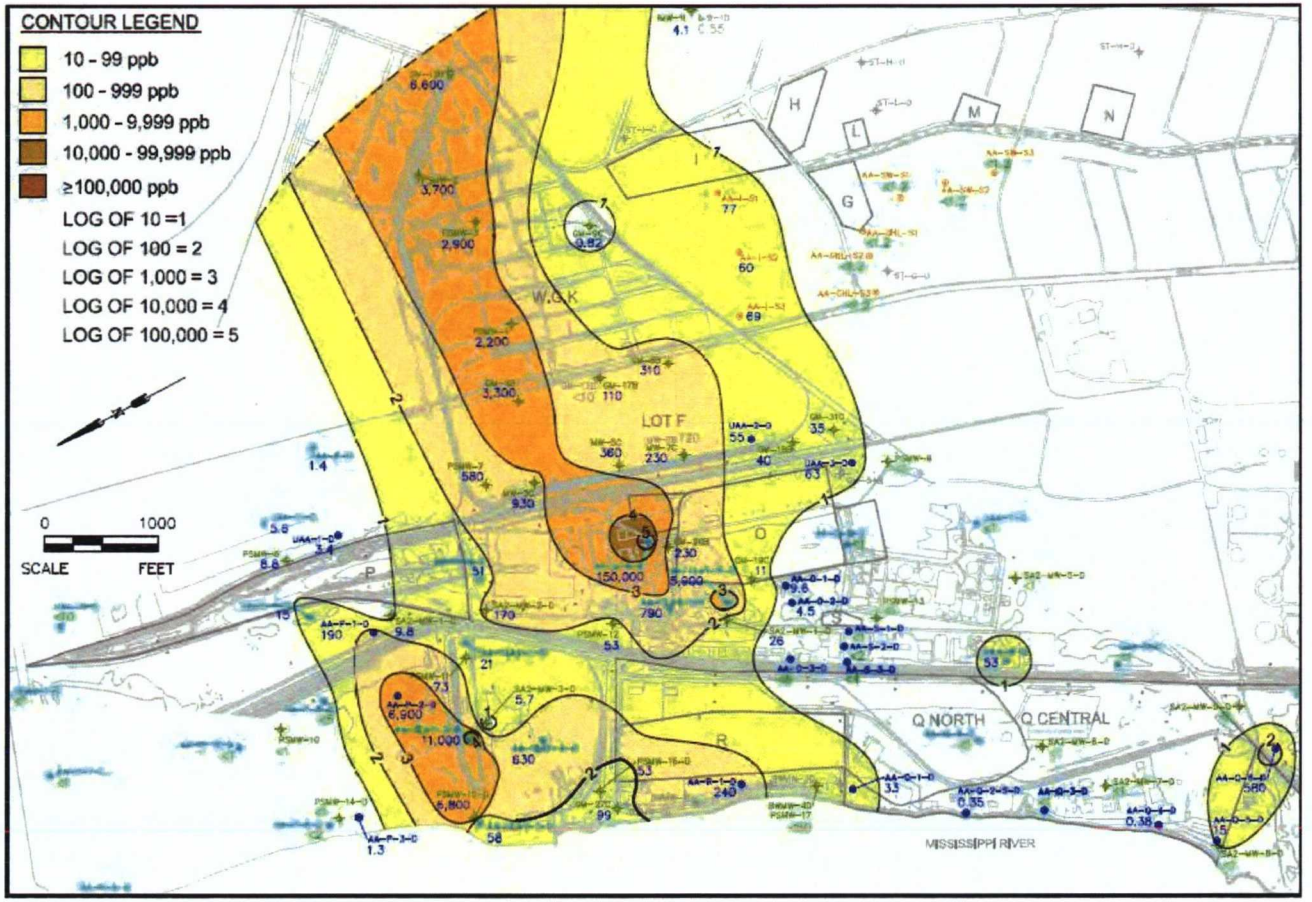

Figure 8. Benzene concentrations and modeled isoconcentrations in the DHU, 2005–2006. Note that north is to the left. The data suggest that benzene may not be moving west toward the GMCS along the river at Site R.

Source: Modified from URS, 2008, Figure 7-28 and GSI Environmental, 2009, Figure 5-23.

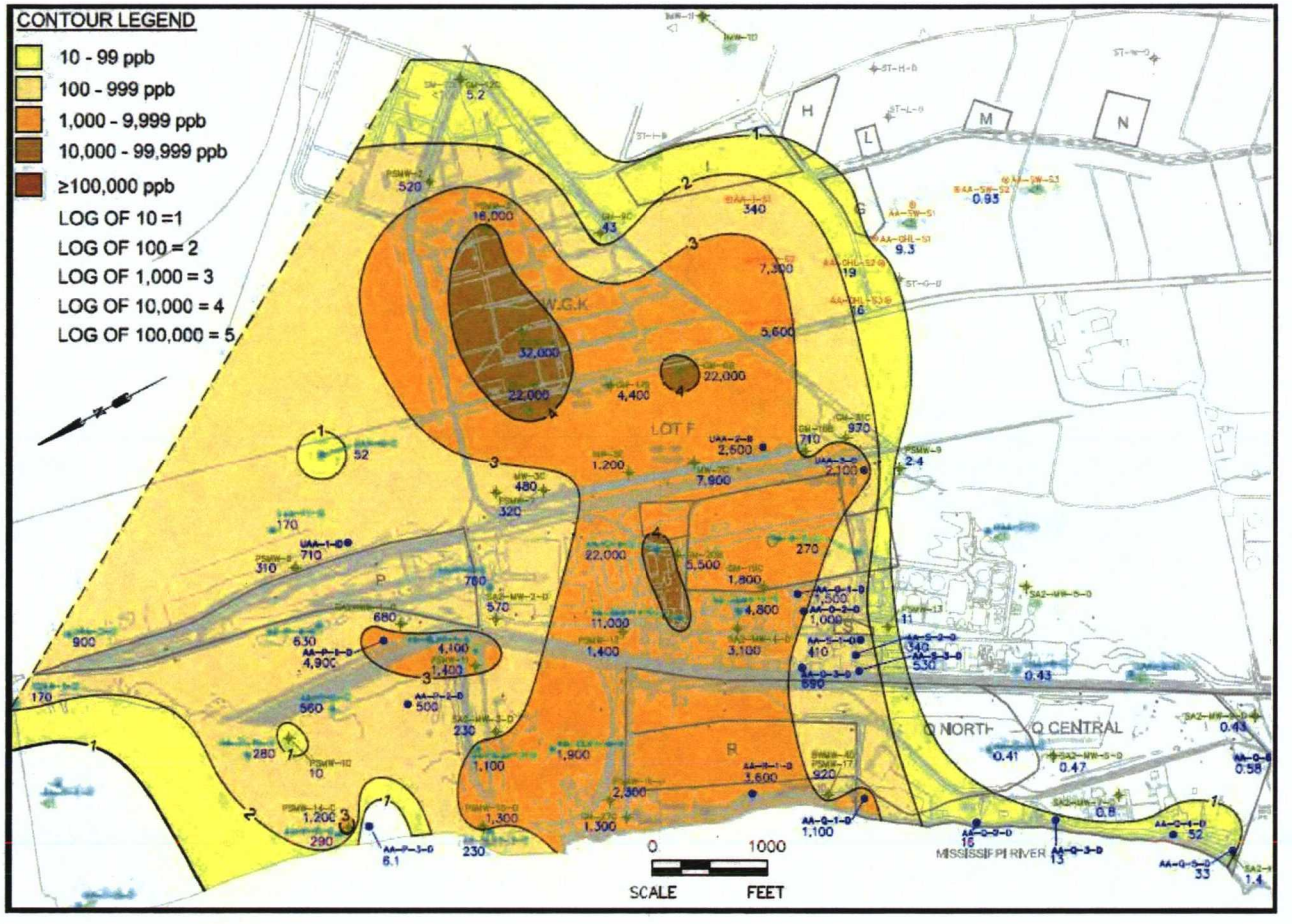

Figure 9. Chlorobenzene concentrations and modeled isoconcentrations in the DHU, 2005–2006. Note that north is to the left. Chlorobenzene is widespread to the north of the source areas, where few wells are available for assessing plume extent.

Source: Modified from URS, 2008, Figure 7-31 and GSI Environmental, 2009, Figure 5-26.

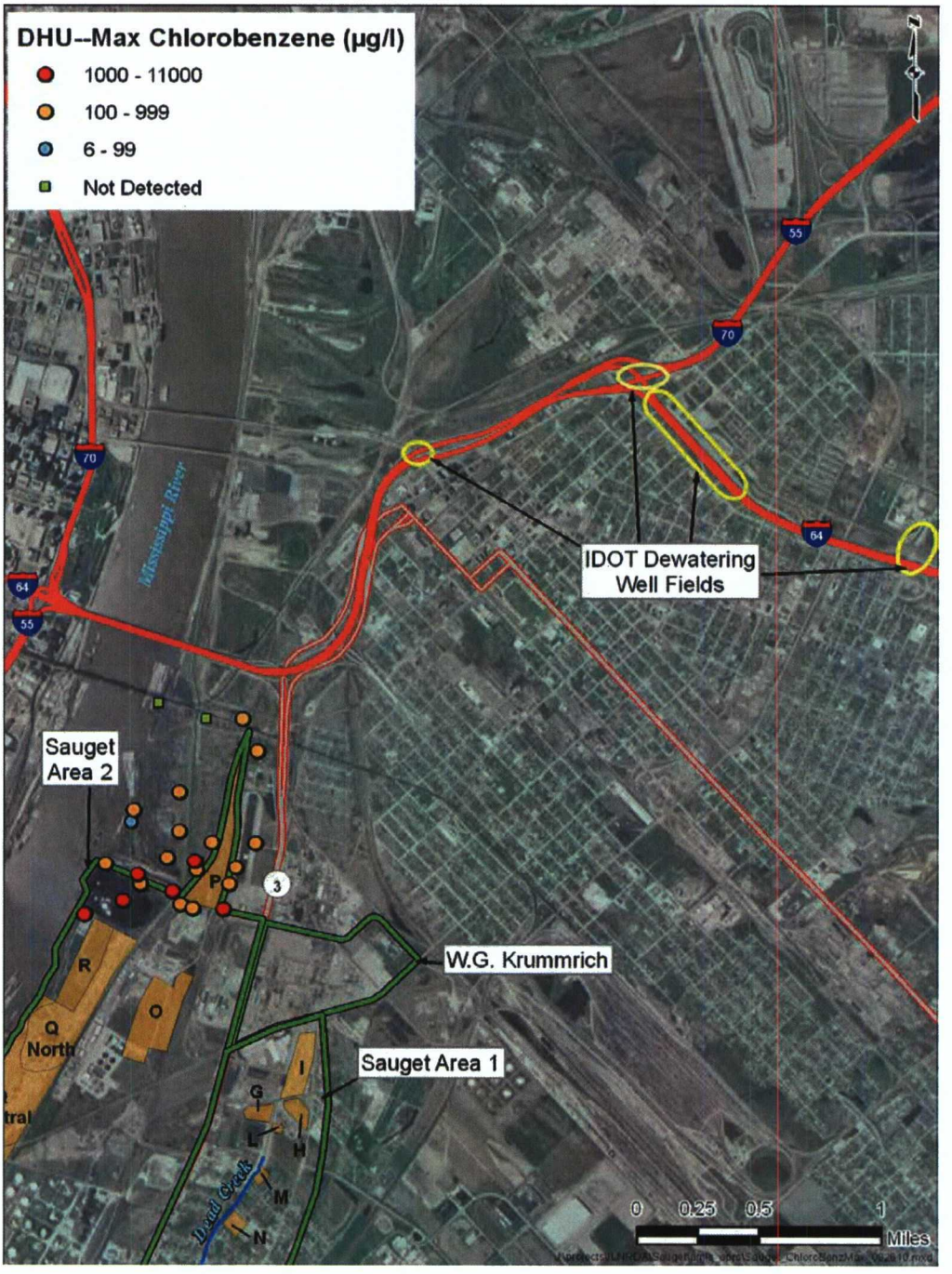

Figure 10. Wells contaminated with chlorobenzene at the north end of the Sauget site. The Federal drinking water standard is 100 µg/L.

Data sources: URS, 2005, 2008.

Similar data gaps are apparent south and east of the W.G. Krummrich plant. For example, the isoconcentrations of benzene in the shallow hydrogeologic unit (SHU) end with an arbitrary dashed line near the eastern boundary of the W.G. Krummrich plant, with no clean wells to confine the plume boundary (Figure 11). In addition, a plume southwest of W.G. Krummrich and southeast of Site Q Central has been depicted based on data from few wells, and includes no clean wells to the east or southeast (Figure 11). Benzene contamination is found northeast of the apparent source, which suggests that the plume may not be moving toward the Mississippi River.

In addition to the benzene and chlorobenzene data gaps in Sauget site groundwater, we note that arsenic concentrations in groundwater exceed the 10 µg/L Federal drinking water standard over a broad area of the site and adjacent to the site. The U.S. Geological Survey (Warner et al., 2003) suggests that background arsenic concentrations in this part of Illinois should be less than 5 µg/L. Arsenic waste was landfilled at Sauget, and the arsenic isoconcentration map in the SHU shows areas of higher concentrations that may correspond to source areas (Figure 12). However, arsenic concentrations in the SHU (as well as in the other hydrogeologic units) are also elevated above drinking water standards along the Mississippi River north of the Sauget site, and northeast of the Sauget site (Figure 12). The sources of arsenic north of the site are not clear, and the extent of the arsenic plume to the north and northeast cannot be established with the existing well network.

In summary, the groundwater elevation contours in the URS (2008) RI report were inferred with no data north and northeast of the Sauget site, where the influence of IDOT pumping would be most apparent. Some contaminant plumes depicted in both the Area 1 and Area 2 RI reports, including benzene and chlorobenzene in the DHU, appear to be migrating at least in part to the north and/or northeast, rather than toward the GMCS at Site R. The benzene plumes in the SHU are also highly uncertain and may indicate eastward or northeastward progression of a plume south of the W.G. Krummrich plant. The data suggest that IDOT pumping could be influencing plume movement. The lack of well coverage and the lack of clean wells confining the depicted plumes result in substantial data gaps.

Finally, arsenic concentrations exceed expected background concentrations and the Federal drinking water standard over a broad area, including areas where the Sauget site appears to be the source, and areas north of the Sauget site along the Mississippi River where the Sauget site may not be the source. The lack of information on the sources, fate, and transport of this arsenic is another data gap in the groundwater characterization at the Sauget site.

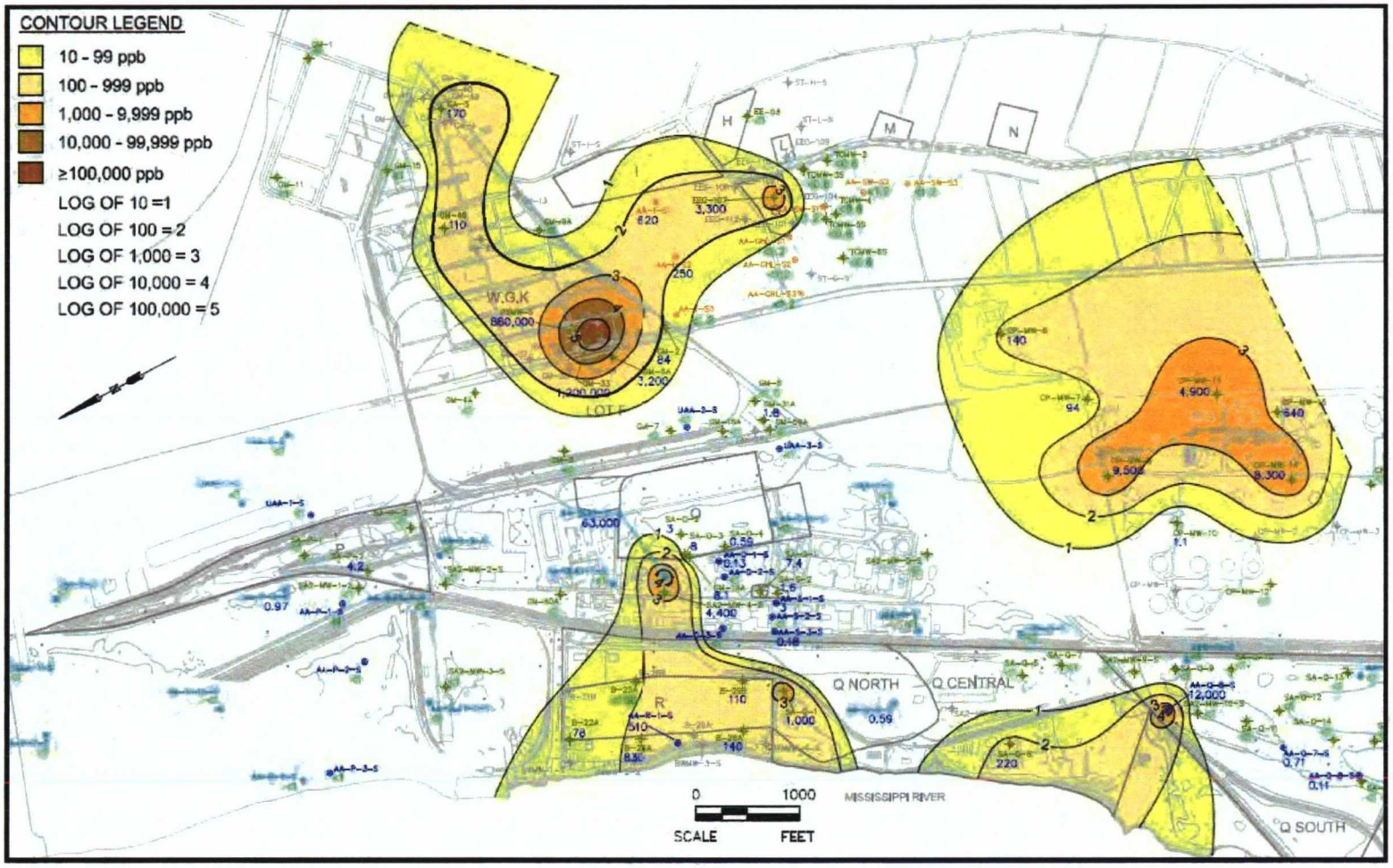

Figure 11. Benzene concentrations and modeled isoconcentrations in the SHU, 2005–2006. Note that north is to the left. The extent of benzene contamination, particularly to the east and southeast, cannot be adequately determined given the well coverage.

Source: Modified from URS, 2008, Figure 7-26 and GSI Environmental, 2009, Figure 5-21.

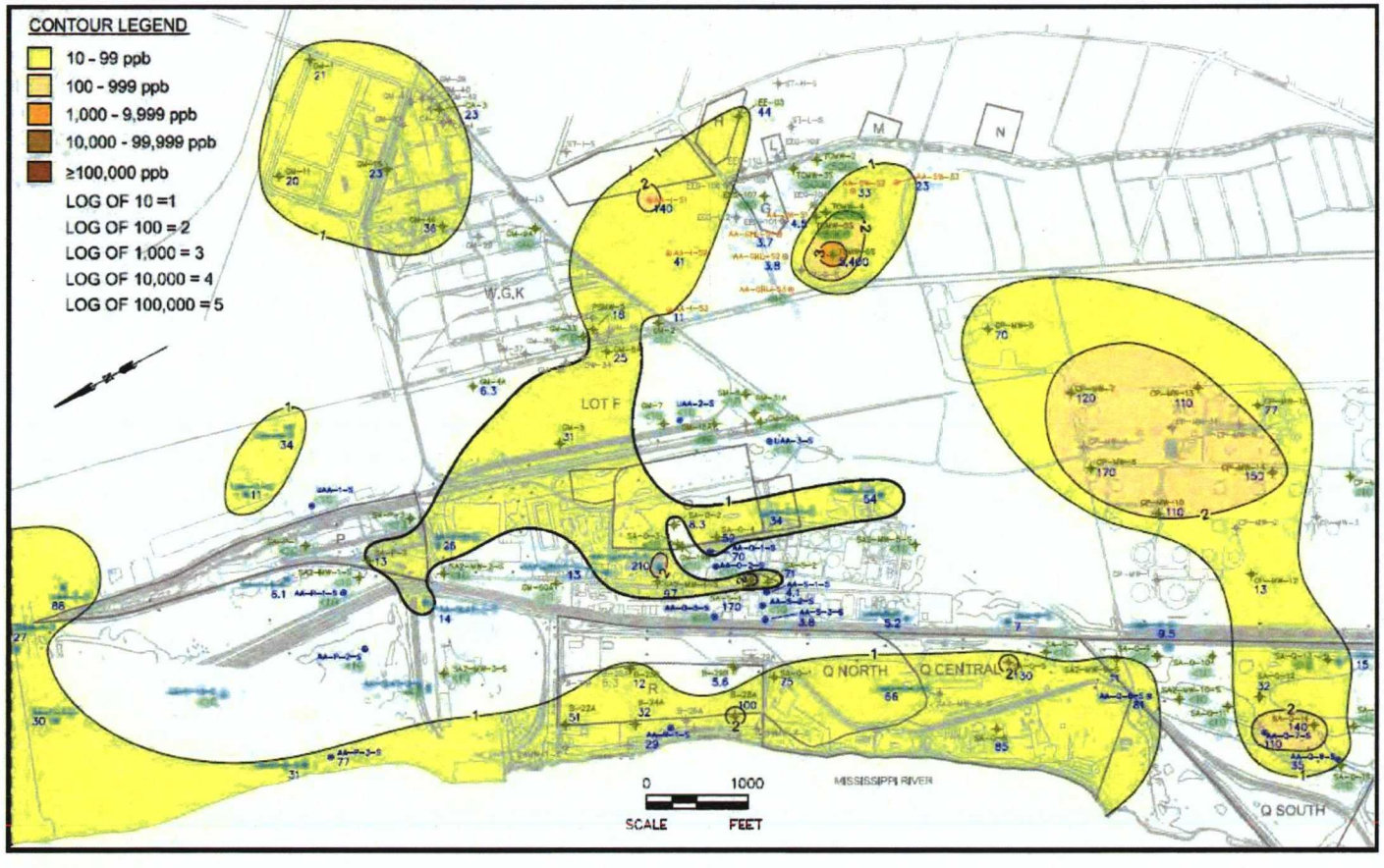

Figure 12. Arsenic concentrations and modeled isoconcentrations in the SHU, 2005–2006. Note that north is to the left. The well coverage is not sufficient to delineate the arsenic plume north of the site. Arsenic along the Mississippi River north of the site may come from a source not related to the Sauget site.

Source: Modified from URS, 2008, Figure 7-65.

4. Recommendations

Given erroneous assumptions and widespread data gaps in the groundwater characterization, we recommend the following:

- GSI Environmental should correct their erroneous assumptions about the IDOT highway dewatering system in their regional groundwater flow model, and then re-run their model and estimate the likelihood that IDOT pumping influences will continue to influence contaminant transport at the Sauget site.
- An expanded well network should be established and included in quarterly groundwater sampling for both water elevation and chemical analysis. Wells are particularly deficient to the north, northeast, and east of the W.G. Krummrich plant, as well as east and south of Area 1 (see Figures 10 and 11). The monitored well network should include uncontaminated wells surrounding all Sauget plumes, allowing constraint of plume size estimates and establishment of sentinel wells for determining plume progression.
- A vapor intrusion study should be conducted in the residential areas northeast of the Sauget site, to determine whether volatile or semi-volatile compounds from the site have been drawn under houses.
- An analysis of the sources, fate, and transport of arsenic in the Sauget/East St. Louis area should be conducted to ascertain the extent of arsenic contamination and determine whether additional remediation is required to address the contamination.
- IDOT should collect and analyze samples from their highway dewatering wells to ensure that no Sauget contaminants are present in the water that they are currently pumping.

In addition, although not directly related to Sauget groundwater contamination, IDOT should consider requesting that TBirdie Consulting re-run their drawdown model, with the southern no-flow boundary placed far enough south that it will not affect the model results. If the model were to show substantial influx of water from south of the current no-flow boundary, additional pumping may be required to maintain water levels below the roadbed, which could subsequently extend the cone of depression farther into contaminated areas at the Sauget site. In addition, the modeled cone of depression could be compared to GSI Environmental model results, which could help to validate each model.

References

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